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(54) ROTARY-PISTON COMPRESSORS

(71) We, BORSIG GmbH a German Company of Berliner Str. 19—37, 100 Berlin 27 BRD, Germany and WANKEL GmbH a German Company of Alt Pichelsdorf 35a, 100 Berlin 20 BRD Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a rotary piston compressor of the kind in which a three-apex piston, rotatably mounted on an eccentric on a shaft, rotates within a housing having a two-lobed trochoidal running surface with which the apices of the piston are in continuous sliding engagement. Such a compressor is referred to below as being of the kind specified.

The known compressors of the kind specified include a counterweight mounted on the shaft and axially spaced from the piston. A disadvantage of this construction is that the size of the piston and counterweight effectively limit the size of the compressor.

The known fully sealed rotary piston compressors are employed primarily in sealed refrigeration circuits or in compressed air braking systems. Their housings are held together by screws in order to secure the disc-shaped components against displacement or rotation, the sealing being achieved by the insertion of sealing means between the individual disc-shaped components. Such constructions require the provision of a substantial number of screws and are expensive to assemble. Furthermore in refrigeration compressors there is a danger of chemical attack on the sealing means which can lead to a serious loss of the working fluid over long periods of time.

Many sealed compressors have been provided in which the screwed housing is enclosed in a casing. U.S. Patent Specification 3,135,460 or German Offenlegungschrift 1,428,050 show examples in which such a casing, comprising a cylindrical part and two end covers, is held together by screws and is closed in a gas-tight and liquid-tight manner.

German Patent Specification 822,393 and German Offenlegenschrift 2,012,233 show examples in which the casing is sealed by soldering or welding. In German Offenlegenschrift 2,012,233 the parts of the housing of the compressor are located in position by two dowels and the end covers are connected to a convex cylindrical peripheral component of the casing by welding. Difficulties arise here in obtaining the necessary pressure for tight assembly of the housing. Accordingly in German Offenlegenschrift 2,012,233 there is proposed the additional use of locating bolts which pass through the cover and the components of the casing and secure them together. However this construction requires a substantial outlay in assembly and leads, on welding, to undesired thermal stresses during welding and on operation, with thermal expansion, to unknown distortions and movements of the components of the housing.

It is the object of the present invention to provide a compressor which substantially overcomes the above-mentioned disadvantages. In particular it is an object of the present invention to provide a compressor having as compact and space-saving construction as possible which is necessary for compressors which are used without maintenance or servicing in closed refrigeration circuits, for example in vehicles, or in braking systems. It is also an object of the present invention to provide a compressor which is simple to assemble and which avoids the cost of manufacture involved in the known constructions which require welding or soldering or screwing together of the components.

According to the present invention we provide a compressor of the kind specified in the opening paragraph above in which a counterweight for the piston and eccentric is mounted on the shaft and situated wholly within the piston.

An embodiment of the invention by way of example only, will now be described in more detail with reference to the accompanying drawings, in which:

Figure 1 shows an axial section through a rotary piston compressor according to the invention, along the line II—II of Figure 2, and

Figure 2 shows the same compressor in a radial section along the line I—I of Figure 1.

The compressor shown includes a housing having a trochoidal two-lobed peripheral running surface 1 and a three-cornered piston 3 which is rotatable about an eccentric 2 mounted on a shaft 2*a* under the control of gearing 4 so to be in continuous sliding contact through its apices with the running surface 1.

The housing comprises three generally disc-shaped components 5, 20 and 30 which are located in position by two dowel screws 39 and 40. An inlet port 6 formed in the outer disc-shaped component 5 communicates with a pocket-like recess 7 formed in the inner surface 8 of the disc-shaped component 5. A similar recess 10 formed on the inner surface of the outer disc-shaped component 30 communicates with the recess 7 through openings 9 formed in the piston 3.

The piston 3 is cup-shaped, the open end facing the outer disc-shaped component 30 and the closed end facing the outer disc-shaped component 5. The openings 9 are formed in the closed end and, as shown in Figure 3, there are three such openings. A counterweight 22 is mounted on the shaft 2*a* within the piston 3. The radially outer periphery 23 of the counterweight forms an arc of a circle with its centre on the axis of the eccentric 2. A part of the counterweight 22 is visible through the lower opening 9 in Figure 2, the remaining part being shown in broken lines. With this construction the counterweight does not increase the overall length of the compressor and accordingly a substantial reduction in the length of the compressor is achieved as compared with the known compressors.

The peripheral edge of a dome-shaped member 24 is seated on and sealingly engages a shoulder 25 machined on the outer surface of the disc-shaped component 5. Memeber 24 has an inlet connector 26 provided in its central dome portion and any suitable supply means (not shown) is screwed into the connector for the supply of the working medium to the inlet port 6 of the housing. The free end of the shaft 2*a* extends through the housing into the dome-shaped member 24. and a balance member 29 mounted on the free end is rotatable within the member 24.

The housing and member 24 are enclosed within a casing 28. The casing 28 comprises a dome-shaped portion 28*a* which overlies the member 24 and is spaced therefrom to provide a hollow space 33 around the member 24 and, a portion 28*b* which extends over the housing. The dome-shaped portion 28*a* has an opening through which the connector 26 extends and an outlet connector 34 in communication with the gap 33. The member 24 separates the high pressure region from the low pressure region and gives increased mechanical stiffness to the casing. The member 24 is weldes to the casing 28 around the connector 26 prior to assembly of the compressor. The portion 28*b* is sealingly connected to the housing by means of an annular shoulder 31 formed in the casing during assembly engaging the outer disc-shaped component 5 and a lip 32 formed in the casing during assembly engaging the outer disc-shaped component 30. The casing thus holds the three disc-shaped components of the housing together under stress. The casing is conveniently pressed onto the housing by means of circumferentially moving press tools indicated diagrammatically at 37 and 38 with a high engaging pressure.

The central disc-shaped component 20 is formed with an annular channel-shaped recess 35 which is continuous apart from where it is interrupted by delivery valves 21, leaving relatively narrow flange portions 36 engaging the associated outer disc-shaped component.

The piston 3 defines with the peripheral running surface 1 two intake chambers 14 and 15 respectively and two compression chambers 18 and 19 respectively. The corners of the recesses 7 and 10 form inlets 2 and 13 to the intake chambers 14 and 18 respectively. Outlets 16 and 17 from the compression chambers 18 and 19 respectively extend through the peripheral running surface 1 and communicate with the gap 33. The outlets 16 and 17 are controlled by respective delivery valves 21 inserted axially in the central disc-shaped component 20. The valves 21 form the subject of our co-pending U.K. Patent Application No. 45530/77 (Serial No. 1581292) to which the reader is directed for further details of their construction and operation. Valves 21 may be replaced by any of the known valves used in compressors of the rotary piston type.

Assembly of the compressor is as follows: the disc-shaped components 5, 20 and 30 are brought together without any seals, after the insertion of the piston 3 and counterweight 22, and are located and joined together by the insertion and tigthening of the dowel screws 39 and 40. The casing 28 is then pressed on by means of the press tools 37 and 38. During the pressing on of the casing, the member 24 which has previously been welded to the casing 28 is simultaneously pressed onto the shoulder 25 and sealed relative to the disc-shaped component 5. When the casing is pressed onto the housing the edges of the outer disc-shaped components and the flange portions 36 are slightly deformed inwards so that any gaps between the components are permanently sealed under the pressure of the bending load in flange portions.

Accordingly it is unnecessary, apart from the provision of the locating dowel screws 39 and 40, to screw the components of the housing together with a large number of screws which was an expensive and time-consuming

operation in the manufacture of known compressors. Preferably the housing is sealed by the provision of a viscous sealing medium in the region of the gaps between the disc-shaped components and the casing thereby eliminating the need for any further housing seals. It is therefore possible to use, in the compressor according to the invention, and without danger, working media which attack the seals required in the known compressors.

It will be apparent from the foregoing that mounting the counterweight 22 within the piston 3 and pressing the casing 28 onto the housing allow the manufacture of a compact and relatively cheap compressor as compared to the known compressors.

WHAT WE CLAIM IS:—

1. A rotary piston compressor of the kind in which a three-apex piston, rotatably mounted on an eccentric on a shaft, rotates within a housing having two-lobed trochoidal running surface with which the apices of the piston are in continuous sliding engagement, wherein a counterwieght for the piston and eccentric is mounted on the shaft and is situated wholly within the piston.

2. A compressor according to claim 1 in which the counterwieght is of arcuate profile with the centre of curvature lying on the axis of the eccentric.

3. A compressor according to claim 1 or claim 2 in which the piston is generally cup-shaped.

4. A compressor according to any one of the preceding claims in which the housing comprises a plurality of disc-shaped components located relative to each other by at least two dowel screws.

5. A compressor according to claim 4 in which the housing comprises three disc-shaped components.

6. A compressor according to claim 5 in which the central disc-shaped component has a circumferential channel-shaped recess around its periphery, the wall portions of the recess defining respective flange portions engaging the adjacent outer disc-shaped components.

7. A compressor according to any one of claims 4 to 6 further including a casing sealingly mounted on the housing, the casing having a shoulder engaging one end face of the housing and a lip engaging the other end face of the housing whereby the disc-shaped components are secured together.

8. A compressor according to claim 7 further including a cover member sealingly mounted on said one end of the housing and defining a delivery chamber in communication with an outlet to the housing.

9. A compressor according to claim 8 in which the casing includes a portion surrounding the cover member to define an outlet chamber in communication with an outlet from the housing.

10. A compressor according to claim 9 in which the cover member has an outlet connector projecting through the surrounding portion of the casing and the connector is secured to the surrounding portion of the casing.

11. A compressor according to claim 7 as dependent on claim 6 in which the flange portions and the adjacent disc-shaped components are inwardly deformed under the pressure exerted by the shoulder and by the lip.

12. A compressor according to any one of claims 7 to 11 including a sealing medium between the casing and the housing.

13. A compressor of the kind specified substantially as hereinbefore described with reference to the accompanying drawings.

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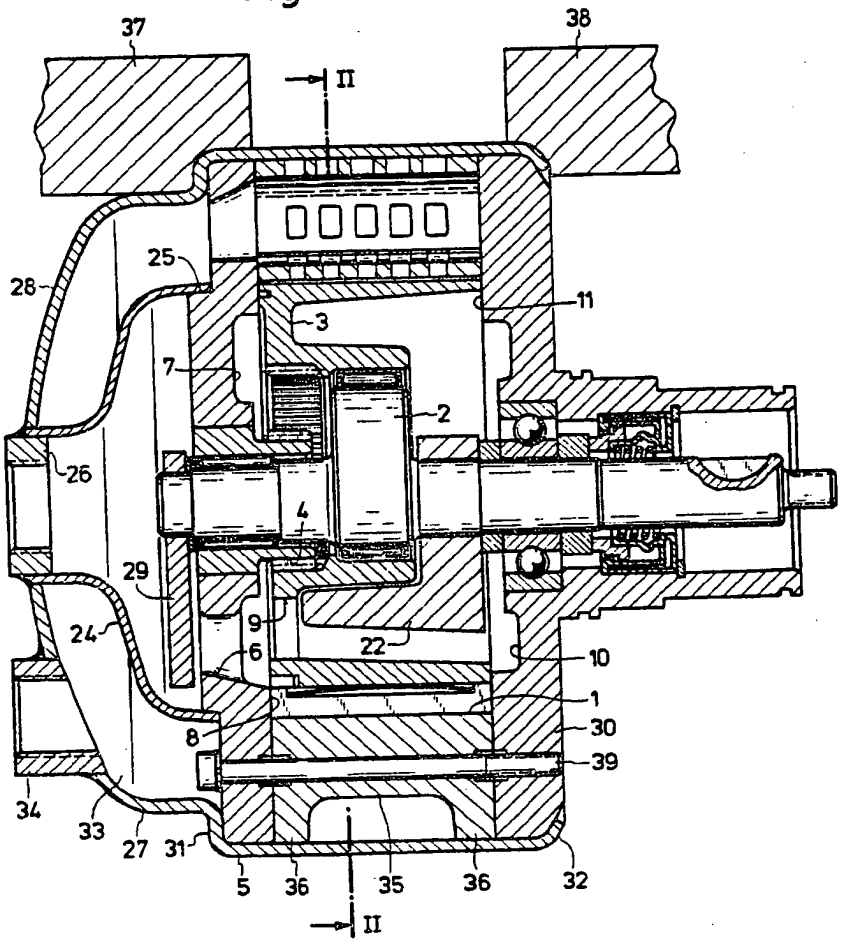
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1



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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

Fig. 2